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AN
EXAMINATION
OF THE
Newtonian Argument
FOR THE
Emptineſs of SPACE,
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AN EXAMINATION OF THE *Newtonian* Argument FOR THE Emptineſs of SPACE, AND OF THE Reſiſtance of ſubtile Fluids.

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> *Homo, naturæ miniſter & interpres, tantum facit & intelligit quantum de ordine naturæ opere vel mente obſervaverit; nec amplius ſcit aut poteſt.* Verulam

by Geo: Martine, M.D.?

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MVSEVM
BRITAN
NICVM

AN
EXAMINATION
OF THE
Newtonian Argument
FOR THE
Emptineſs of SPACE, *&c.*

Naturally we are not apt to aſcribe exiſtence to any thing but what we either feel or ſee: and it is by a train of arguments, and reaſoning from effects to their cauſes, that we come to conceive other things beſides groſs ſenſible bodies. When we firſt begin to look about us in the world, are we not ready to fancy the air ſurrounding us, and in which we move ſo freely, to be an empty ſpace? But a few common obſervations, and a little reflection, ſoon correct that miſtake, and teach us that it is a fluid, which, though inviſible, and far from being ſo ſubſtantial as water, has yet body enough to diſcover itſelf very ſenſibly in reſiſting and retarding the motions of bodies, or when itſelf is moved or carried along with ſufficient quickneſs and force.

2. If once we find ourſelves in a miſtake, we become ever afterwards ſomewhat ſuſpicious of any thing that nearly reſembles that which deceived us. The air ſurrounding us we once heedleſsly thought a void, which now we evidently find to be a material fluid. And thence we are prone to fancy other ſpaces beyond the air to be ſomething of the ſame nature;

nature; and the ſun, moon and ſtars to move in a ſubtile air, or an ætherial fluid, filling up the cœleſtial ſpaces; in a word, *παν πληρης——κενον τε μη ειναι.*

3. The Philoſophers who maintained a doctrine ſo extraordinary, and ſo remote from the common ſenſes of mankind, took very extraordinary ſteps to illuſtrate and eſtabliſh their ſyſtem. The Peripateticks denied the poſſibility of rendering any place empty of matter, alledging that nature abhorred a void. And when any body was transferred from one place to another, *Plato* thought it muſt diſplace as much matter, which would impel an equal quantity before it, and that another, and ſo on till it go round *πεϱιωσει*, by a ſort of Circumpuloion; as

——The floods give fiſhes way,
Who cut their paſſage through the yielding ſea:
Becauſe they leave a ſpace where-e're they go,
To which the yielding waters circling flow.

And Mr. *Des Cartes* affirms in expreſs terms, and made it a main part of his ſyſtem, that extended ſpace and ſolid matter were the ſame thing, and only conceived and expreſſed in different names and characters.

4. But there were other philoſophers, and thoſe too of the greateſt name and antiquity, who truſted more to their ſenſes than to their imagination. They were not fond of a needleſs multiplicity of beings; and ſo could not find any ſufficient

reaſon

reaſon to convince them of ſpace being full of matter. On the contrary, they thought the far greateſt part of the infinite expanſe to be intirely void of any ſuch ſubſtance; and that an infinite number of bodily atoms, and maſſes made up of theſe atoms, were diſtributed into worlds, through the great ocean of interminable ſpace.

5. Many are the arguments adduced to prove body and ſpace to be different. *Epicurus*, inſtructed in the philoſophy of *Leucippus* and *Democritus*, was very full in endeavouring to ſhew the neceſſity of a void, to allow bodies the free motions we ſee them perform: whoſe reaſonings are preſerved to us, and finely ſet off by *Lucretius*; which we find the moderns, particularly the famous *Borelli*, copying and carrying

to a height that has a great look of demonſtration.

6. But what is moſt of all inſiſted on now a-days is the different reſiſtances bodies meet with in their motions through various fluids: theſe reſiſtances, in as far as they ariſe from the *Inertia* of matter, being always found proportional to the denſities or ſpecific weights of the *mediums* through which they are propelled; any diviſion or ſubtilization of particles, or any other change of circumſtances (except ſolely the diminution of denſity) being of no conſequence to take off their innate force of reſiſtance. So that when we find bodies moving with little or no reſiſtance, we may conclude the medium, in which they move, to have little or no denſity, or to be almoſt or altogether devoid of matter.

ter. Thus Sir *Iſaac Newton* *, by a great many experiments very well and carefully made on pendulums and falling bodies, has ſhewn, that balls moving in quick-ſilver, water and air, are reſiſted juſt in proportion to the reſpective ſpecific weights of theſe fluids, or their denſities of gravitating matter: and conſequently, ſince we find bodies in our artificial *vacuums*, and the planets in the celeſtial ſpaces meet with little or no reſiſtance **, we muſt infer, that theſe unreſiſting ſpaces are entirely empty, or at leaſt have inconceivably little matter in them.

7. But I humbly think this argument, however plauſible, yea de-

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* Princip. Phil. Matth. II. p. 307,——315. 349,——354.

** Newton, ibid. p. 355, 356, 385, 484, 514, 527. Opt. p. 340, 341, 342, 343.

monſtrative it may appear at firſt ſight, is yet not ſo general and concluſive as is commonly given out. Is it not founded entirely upon experiments made on gravitating fluids, whoſe particles, however attenuated by our art, are ſtill ſo groſs as not to paſs through the pores of the immerſed bodies, and ſo act ſolely on their exterior ſurfaces? The reſiſtance of ſuch muſt indeed be proportional to their denſities. But is it not too wide a ſtep from thence to conclude the ſame of all fluids whatſoever, even of thoſe that may be reckoned exempt from gravity, and groſſneſs of parts, and which are ſuppoſed freely and eaſily to paſs through the pores of immerſed bodies, ſuffering only ſome ſmall impediment as they happen to ſtrike againſt their ſolid particles? We know for certain that the moſt ſolid and compact bodies we have are very porous. I would not indeed venture to affirm, as ſome *Newtonians* do, that a body perfectly ſolid is as much denſer than gold, as gold is denſer than light, or what they conceive æther to be. I do not ask near ſo much. But we know, I ſay, that all the moſt compact bodies we have are ſtill very porous. How eaſily, and without the leaſt ſenſible loſs or reſiſtance does the magnetic virtue paſs thro' the thickeſt cakes or *ſtratums* of gold, quick-ſilver or lead? How do the ſteams of the *Bolonian* ſtone affect and change the colour of ſilver into yellow, and that of braſs into white, though cloſely locked up in a box of iron, or other metal? How is the inviſible writing in the ſympathetic ink affected through many hundred leaves of paper, and even plates of metal, or through a wall, by an imperceptible penetrating virtue, ſo as to become black, and as legible as common writing? How are the electric forces conveyed along and through denſe ſolid bodies? And the eaſy paſſage of light and fire through bodies, impervious to moſt other things, has been often taken notice of. So that all the ſolid or conſiſtent bodies we are acquainted with ſeem to be ſufficiently porous. Now what if there was a fluid made up of particles ſo very minute, round and ſmooth, or any other way you pleaſe to conceive, ſo figured and attenuated, as freely and eaſily not only to ſlide over one another, and yield to the leaſt impreſſed force, but freely and eaſily to pervade *undequaque* our pendulums and falling bodies, and the planets and comets moving in the cœleſtial ſpaces? In that caſe would not the reſiſtance theſe bodies met with (ariſing chiefly from their ſolid particles impinging againſt the fluid) be almoſt infinitely little, however denſe this fluid were? At leaſt while we are in a hypothetical humour, we may ſuppoſe the immerſed bodies to be as rare or porous, and the conſtituent particles of our *medium* to be as ſmall, round and ſmooth as we pleaſe; and ſo bring its permeability to be as great, and conſequently its force of reſiſtance to be as ſmall, as we think fit. So that we ſee the ſubtilization of particles, if it be carried on far enough, can greatly diminiſh, nay almoſt take away the reſiſting force of fluids without altering their denſity. And does not this conſideration, as I juſt now propoſed to ſhew, very much weaken, if not entirely take off Sir *Iſaac*'s

Argument, given out commonly as a Demonſtration; that our air-pump *vacuums* and the heavens, having no ſenſible reſiſtance, are therefore intirely, or almoſt intirely, devoid of matter? Surely the queſtions of ſpace, and *vacuum*, and elements, *&c.* muſt be very abſtruſe and difficult in their nature, when they cannot be determined from the principles and obſervations of that truly great man, even when he was ſo bent and keen in his enquiries upon theſe points, and thought he had ſo firmly eſtabliſhed them. If he was deluded by a ſhadow, who ſhall with any degree of certainty come at the reality of things? and who will undertake never to be led away by fond and vain reaſonings, and ſpecious appearances of truth?

8. I would not therefore be underſtood by all this, obſtinately to aſſert the exiſtence of ſuch an æthereal *medium* as I have been deſcribing, whether denſe or rare: that is what would take time and pains to diſcuſs. Much leſs would I maintain an abſolute *Plenum*, and the identity of ſpace and matter. I only alledge, that Sir *Iſaac*'s argument for the emptineſs or extreme rarity of artificial *vacuums*, and of the cœleſtial regions, does not ſeem to conclude ſufficiently. "Ita nihil ut af-"firmem, quæram omnia, dubitans "plerumque & mihi ipſe diffidens †." I own indeed that his experiments ſhew, that the reſiſtance of common heavy and groſs fluids is in proportion to their ſpecific weights,

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† Cicer. de Divinat. II. 3.

or to their denſities of gravitating matter. But that does by no means determine any thing of the nature and ſmall denſity of pervading or ungravitating ones, whoſe reſiſtance, and action on immerſed bodies is performed in ſo different a way. Nor does it evince the quantity of matter in given bulks of ſolid and fluid bodies to be in that porportion of their ſpecific weights; as is commonly concluded, not only from thoſe experiments, but from the laws of the motions and forces of bodies. A cubical inch of gold has near twice as much weight, or twice as much gravitating and reſiſting particles, as the ſame bulk of ſilver: and mercury has almoſt fourteen times more than an equal bulk of water; though the real quantity of matter made up of gravitating particles, and interſperſed ſubtile matter

ter (if there be ſuch) in all theſe different bodies may be nearly the ſame, for ought we certainly know. In a word, I ſee no reaſon why there may not be matter without gravity, and endowed with little or no reſiſtance in the way we have explained.

9. Indeed, in ſpeaking and reaſoning about theſe things, moſt of the diſciples of Sir *Iſaac Newton* take for granted the univerſal and equal gravitation or attraction of all the parts of matter one to another. But though this rule were allowed to be true enough of all groſs matter, of which we have had opportunities of making trials *: upon what

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* There are, however, many inſtances of ſome bodies having rather a contrary tendency, avoiding, as it were, a mutual contact, and endeavouring to recede from one another by a repelling, inſtead of an attracting, or mutually gravitating force, as in the phænomena of magnetiſm, electricity,

what grounds this ſhould be extended beyond our ſolar ſyſtem, or applied to ſubtile fluids, as light or fire, or interſperſed æther (in caſe ſuch a thing be) I know not. It will not be eaſily made out, that gravitation is eſſential to matter. Sir *Iſaac* himſelf [*], and the moſt judicious of his followers, diſavow ſuch a principle. Yea there are many not contemptible philoſophers, who ſpeak of fluids (even in this ſyſtem) not ſubject to that common law. Many of the ancients maintained an ætherial element of *fire*, pervading and actuating every thing, as diſtinct and independent on other bodies. M. *Homberg*, *Gulielmini* and Dr. *Boerhaave*, have with many plauſi-

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tricity, the mixture of heterogeneous liquors, the application of dry bodies to them, the inflexions and reflexions of the rays of light in their approach to groſs bodies, *&c.*

[*] Princip. Phil. Math. p. 389.

ble arguments endeavoured to replace this, or ſomething like this antiquated element. And this *Boerhaave*[*], after his moſt careful reſearches, tells us, ſeems exempt from gravity. Nay, even Sir *Iſaac Newton*'s Æther, or *Spiritus omnia pervadens*, is deſcribed by himſelf [||] as not ſubject to gravitation. Contrariwiſe, it is rareſt within and near the bodies of planets, and other compact and denſe bodies, increaſing in denſity as it removes from them, *&c.* and ſo is itſelf the cauſe of the mutual attraction, *&c.* of bodies [**]. And others have undertaken to ſhew [†], that the taking off the gravity of a fluid, however denſe it may be, does alſo take off the force of reſiſtance, and renders that abſolutely inſenſible.

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[*] Chem. I. p. 198, 360, 389.
[||] Opt. p. 324, 325.
[**] Ibid. & Princip. p. 530.
[†] Vid. Hiſt. Acad. Scienc. 1731. p. 92, &c.

10. The great men in all ages, turning their heads the ſame way, have been ready to fall into the ſame, or nearly the ſame thoughts, though they have expreſſed themſelves in very different manners. May not the *ignis* of ſome folks, the *æther* of others, the *materia ſubtilis* of others, be at bottom (when thoroughly explained) one and the ſame thing; and producing the wonderful *phænomena* of attraction, gravitation, coheſion, magnetiſm, elaſticity, *&c*? And may it not, for ought we can affirm to the contrary, be denſer than any ſenſible fluid we know, immenſely denſer than oil of vitriol, melted metals, quick-ſilver, or any thing elſe? And though ſuch

a denſe, ſubtile fluid ſhould pervade and fill the pores of ordinary bodies, as air, water, or quick-ſilver, I do not ſee that their reſiſtance would be ſenſibly altered thereby, as Sir *Iſaac Newton* and others alledge. On the contrary, ſolid maſſes immerſed in ſuch groſs fluids would perform their motions in them with the ſame freedom they would do, if their pores were entirely empty of matter; the denſe and ſubtile fluid, of the properties we juſt now deſcribed, being ſcarcely diſtinguiſhable from a void by our ordinary experiments. As I am no mathematician, I may poſſibly be miſtaken in all this, and I ſhould be fond to be inſtructed by better Judges. In the mean time, an inviſible, imperceptible and penetrating *medium* ſeems to be, at leaſt its exiſtence is ſuppoſed by all; the common phænomena ſeem to require it. And I do not ſee that its extreme rarity and thinneſs is yet fully and clearly evinced by any arguments or juſt reaſoning. Yea that it not only exiſts, but that it hath ſome, though very ſmall, reſiſtance acting upon the ſolid particles, or internal ſubſtance of bodies, and altogether diſtinct from the reſiſtance of ordinary fluids, as air, water, quick-ſilver, *&c.* which act ſolely on their exterior ſurfaces, ſome will be ready to infer from an experiment of Sir *Iſaac* himſelf *(Princip.* p. 316, 317.) though the leaſt accurately recorded one in his book.

11. Sir *Iſaac*, indeed, in the firſt edition of his *Principia* *, propoſing

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* Princip. Edit. I. p. 353.

this experiment to the world, endeavoured to take off its natural tendency, towards ſhewing ſome reſiſtance acting on the internal parts of bodies. But in thoſe days ‖ he was bent upon demoliſhing the *Carteſian* ſyſtem of *Vortices* and ſubtile matter: and all along ſhews a great keenneſs for eſtabliſhing the atoms and great *Inane* of *Moſchus* the *Phœnician*, which *Leucippus* introduced into *Greece*, and which made a fundamental article in the philoſophy of *Democritus* and *Epicurus*. But our *Britiſh* philoſopher in his riper days became much leſs ſanguine that way. In his latter editions he allows that experiment its due weight: and he not only fills the heavens with the rays of light, and the thin vapours of ſuns, comets and planets **; but is fond to introduce a *Spiritus ſubtiliſſimus corpora craſſa pervadens*, an omnipreſent æther, as the great agent in nature, cauſing attraction, coheſion, electricity, the motions and modifications of light and heat, animal ſenſations and motions, *&c* *. But he wanted time and experiments to aſcertain its laws of acting. However, he has attempted to determine ſome of its properties, and to explain many of its operations, as far as his obſervations and reflections could carry him †.

‖ Ibid. & p. 339, 382, 383, 384, 504.

** Ibid. p. 502, 503, 506. Edit. III. p. 356, 512, 513, 515, 526. Opt. p. 343.

* Princip. Edit. III. p. 530.

† Opt. p. 323,——328, 339, 343, 349.

F I N I S.

Erratum: Page 3. line 21. *read* Circumpulſion.